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IS 14500 (1998): Linear low density polyethylene (LLDPE) films [PCD 12: Plastics]

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Indian Standard

LINEAR LOW-DENSITY POLYETHYLENE (LLDPE) FILMS — SPECIFICATION

ICS 83.080.20

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

March 1998

Price Group 2

Plastics Sectional Committee, PCD 12

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Plastics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Linear low-density polyethylene (LLDPE) is an inert plastic material and belongs to the family of polyethylenes. It is co or terpolymer of ethylene with 1-alkene produced by fludized bed gas, solution, slurry or high pressure polymerization process.

The linear term in LLDPE refers to the arrangement of ethylene molecules in a straight line, with short uniform side branches generated from addition of comonomers. The distinctive characteristics of the molecular structure of LLDPE affects its rheological and morphological behaviour in comparison to conventional low-density polyethylene (LDPE). LLDPE is prefered when small diameter pipes are extruded and the same material is used to manufacture film for landfills and waste ponds, extruded sheeting, and injection moulded articles.

LLDPE film due to its better mechanical properties, heat seal and hot tack properties/sealing through contaminants, hot-tack compared to LDPE films, are extensively used in liquid packaging particular for milk. LLDPE lamination films are used for packaging foodstuffs, shampoo, detergent, etc. These considerations led the committee to formulate this Indian Standard on linear low density polyethylene (LLDPE) films.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

LINEAR LOW-DENSITY POLYETHYLENE (LLDPE) FILMS — SPECIFICATION

1 SCOPE

1.1 This standard prescribes the requirements, methods of sampling and tests for linear low density polyethylene films for packaging and allied purposes.

1.2 This standard covers flexible unsupported tubular films of 10 to 100 micron in thickness made from natural compound of linear low density polyethylene having density between 908.4 to 938.4 kg/m^3 at 27°C (910 to 940 kg/m^3 at 23°C).

1.3 Coloured film other than black shall be as agreed to between the supplier and the purchaser.

2 NORMATIVE REFERENCES

The following Indian Standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
2508 : 1984	Specification for low density polyethylene films
2828 : 1964	Glossary of terms used in plastics industry
4905 : 1968	Methods for random sampling
10141 : 1982	Positive list of constituents of polyethylene in contact with foodstuffs, pharmaceuticals and drinking water
10146 : 1982	Polyethylene for its safe use in contact with foodstuffs, pharmaceuticals and drinking water
13360 (Part 3/ Sec 1) : 1995/ ISO 1183 : 1987	Plastics — Methods of testing: Part 3 Physical and dimensional properties, Section 1 Determination of density and relative density of non-cellular plastics

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 2828 and the following shall apply.

3.1 Linear Low Density Polyethylene (LLDPE)

It is a co or terpolymer of ethylene produced by catalytic polymerization of ethylene with other 1-alkenes having density in the range of 908.4 to 938.4 kg/m^3 at 27°C (910 to 940 kg/m^3 at 23°C).

4 MATERIAL

4.1 The material used for manufacturing natural film shall be linear low density polyethylene, having density between 908.4 to 938.4 kg/m^3 at 27°C (910 to 940 kg/m^3 at 23°C). Any additives, to impart additional qualities to the film such as antioxidant, antiblock, slip, etc, may be added to the resin in quantity as agreed to between the supplier and the purchaser. For black film, the percentage of carbon black in material shall be 2.5 ± 0.5 percent by mass.

4.2 When the film is meant for food contact applications the compound shall also comply with the requirements of IS 10141 and IS 10146.

5 CLASSIFICATION

5.1 The film shall be classified according to its impact strength, optical and slip properties. Each class of sample shall be designated by a set of three numerals. The first one will indicate impact strength, second one optical property and the third slip property. Whenever numeral '0' is used, it shall mean the material has not been tested for that particular property.

5.2 For impact strength, numeral '1' shall indicate low impact strength, numeral '2' medium impact strength and numeral '3' high impact strength. For optical properties the numeral '1' shall mean high haze, numeral '2' medium haze and numeral '3' low haze. For slip property numeral '1' shall denote no slip, numeral '2' low slip, numeral '3' medium slip and numeral '4' high slip.

Examples

i) Class 302 — This shall mean that the film has high impact strength, it has not been tested for optical properties and it is of low slip.

ii) Class 224 — This shall indicate that the film is of medium impact strength, medium haze and high slip.

6 REQUIREMENTS

6.1 General

6.1.1 *Appearance*

The film shall be uniform in colour, texture and finish. The material shall be free from streaks and foreign particles. There shall be no other visible defects, such as holes, tears or blisters. The edges shall be free from nicks and cuts visible to unaided eye. The natural films shall be free from pinholes.

6.1.2 *Film Form*

The film shall be furnished in the form of flat sheet or rolls or in the form of flat tubing or in any other form as agreed to between the supplier and the purchaser.

6.1.3 *Odour*

The film shall be free from any objectionable odour.

6.1.4 *Density*

The density of the film, when determined in accordance with IS 13360 (Part 3/Sec 1)/ISO 1183 shall be as prescribed in **4.1.**

6.2 Dimensional Requirements

6.2.1 *Nominal Thickness and Nominal Width*

a) Nominal thickness is the desired thickness of a film for a particular application, and

b) Nominal width is the desired width of a film for a particular application.

6.2.2 *Tolerance on Thickness*

When tested in accordance with **A-2** of IS 2508 tolerance on nominal thickness at any given point for various thickness shall be as given in Table 1.

Table 1 Tolerance on Nominal Thickness

Nominal Thickness (1)	Tolerance, Percent (2)
Up to and including 50 µm	±20
Above 50 µm	±15

6.2.3 *Tolerance on Width*

The tolerance on width shall be as given in Table 2.

Table 2 Tolerance on Width

Nominal Width (1)	Tolerance, mm (2)
Up to 500 mm	±5
Above 500 mm and up to 1 250 mm	±8
Above 1 250 mm	±20

6.3 Yield Tolerance

The actual yield shall be determined in accordance with the method given in **A-3** of IS 2508 and shall be within the following tolerance limits of the nominal yields :

	Yield Tolerance, Percent
One roll	± 10 percent
Lots of 250 kg	± 10 percent
Lots over 250 kg and up to 1 250 kg	± 5 percent
Lots over 1 250 kg	± 3 percent

6.4 Physical Properties

6.4.1 *Impact Strength (Falling Dart)*

When tested by the procedure given in **A-6** of IS 2508 the impact failure load obtained from the drop of 66 cm shall not be less than that given in Table 3 for appropriate average thickness of film.

Table 3 Impact Failure Load

Average Thickness of Film (µm)	Impact Failure Load (g)		
	Numeral-1	Numeral-2	Numeral-3
(1)	(2)	(3)	(4)
30	—	75	105
50	75	125	175
70	105	175	245
100	150	250	350

NOTE — The values for impact load for intermediate thickness may be obtained by interpolation.

6.4.2 *Haze*

Haze of the film made from LLDPE, when tested in accordance with **A-5** of IS 2508 shall conform to the requirements given in Table 4.

Table 4 Requirements for the Haze of the Film

Numeral (1)	Film Clarity (2)	Percent Haze (3)
1	Low	>15
2	Medium	10 to 15
3	High	<10

6.4.3 *Slip*

The kinetic coefficient of friction (COF) of film made from LLDPE when tested in accordance with **A-7** of IS 2508 shall be as given in Table 5.

Table 5 Requirements for Kinematic Coefficient of Friction

(*Clause* 6.4.3)

Numeral (1)	Slip (2)	COF (3)
1	No	> 0.70
2	Low	> 0.40 up to 0.70
3	Medium	> 0.20 up to 0.40
4	High	≤ 0.20

6.4.4 *Tensile Strength at Break*

The minimum tensile strength at break when tested as prescribed in **A-4** of IS 2508 for various thicknesses of linear low density polyethylene films, at different levels of impact strength, shall be as given in Table 6.

Table 6 Tensile Strength at Break

	Tensile Strength at Break, (MPa)		
	Low Impact Strength Film (1)	Medium Impact Strength Film (2)	High Impact Strength Film (3)
Machine direction (MD)	22	30	35
Transverse direction (TD)	18	25	30

6.4.5 *Elongation at Break*

The elongation at break when tested as prescribed in **A-4** of IS 2508 for various thicknesses of linear low density polyethylene film, at different levels of impact strength, shall be not less than the values given in Table 7.

Table 7 Elongation at Break

Thickness of Film		Elongation at Break, Percent		
		Low Impact Strength Film	Medium Impact Strength Film	High Impact Strength Film
(1)		(2)	(3)	(4)
From 10 µm up to but not including 50 µm	(MD)	300	400	500
	(TD)	400	500	600
50 µm and above	(MD)	500	600	700
	(TD)	600	700	800

7 PACKING AND MARKING

7.1 Packing

The roll/folded polyethylene film shall be packed as agreed to between the purchaser and the supplier.

7.2 Marking

Each roll/folded film shall be marked legibly with the following information:

a) Indication of the source of manufacture, name and recognized trade-mark, if any;
b) Class of the film;
c) Width of the roll/folded film;
d) Mass of the roll/folded film;
e) Thickness of the film; and
f) Batch number and date of manufacture.

7.3 BIS Certification Marking

The rolls/folded films may also be marked with the Standard Mark.

7.3.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act,* 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

8 SAMPLING

8.1 Lot

In any consignment, all rolls/folded films of the same grade shall be grouped together to 'constitute a lot'.

8.1.1 Tests for determining the conformity of the lot to the requirements of the specification shall be done on each lot separately. The number of rolls/folded films to be selected for this purpose shall be in accordance with col 2 of Table 8.

8.1.2 The rolls/folded films shall be selected at random from the lot. In order to ensure randomness of selection, procedures given in IS 4905 may be followed. Alternately, the following procedure may be adopted:

> Starting from any roll/folded film in the lot, count them in one order as 1, 2.........etc, upto *r* and so on, where *r* is the integral part of *N/n*. Every *r*th roll/folded film thus counted shall be withdrawn till the required number of rolls/folded films are taken from the lot.

8.2 Number of Tests and Criteria for Conformity

8.2.1 From each of the roll/folded films selected according to **8.1.2** approximately 10 m^2 of the film of full width shall be cut, care being taken to exclude not less than 2-metre lengths of film (or three full turns of the roll) from either end. The test specimens for the various tests shall be cut from different parts of each of the 10 m^2 pieces.

8.2.2 Each of the pieces as obtained in **8.2.1** from a lot shall be examined for general requirements (**6.1**) dimensional requirements (**6.2**) and yield tolerance (**6.3**), Any piece which does not meet the requirement of any of the above characteristics shall be considered as defective.

8.2.3 If the number of defectives found (*see* **8.2.2**) is less than or equal to the corresponding permissible number of defectives given in col 3 of Table 8, the lot shall be tested for the remaining requirements of the specification. If the number of defectives found is more than the corresponding permissible number given in col 3 of Table 8, one more lot of samples may be examined.

8.2.4 The lot having been found satisfactory according to **8.2.3** shall be tested for physical properties (**6.4**). For this purpose the rolls already tested according to **8.2.2** and found satisfactory shall be used for testing any of these characteristics. Specimen(s) for these tests shall be cut from 10 m^2 piece already taken from each roll/folded film selected (*see* **8.2.1**).

8.2.4.1 The lot shall be deemed to have satisfied these requirements if all the test results for different characteristics given in **8.2.4** are found meeting the relevant requirements of the specification.

Table 8 Scale of Sampling and Permissible Number of Defectives

(*Clauses* 8.1.1 *and* 8.2.3)

Lot Size (*N*) (1)	Number of Rolls/Folded Films to be Selected (*n*) (2)	Permissible Number of Defectives (3)
1	1	0
2 to 15	2	0
16 to 40	3	0
41 to 65	5	0
66 to 110	7	0
111 to 180	10	0
181 to 300	15	1
301 to 500	25	1
501 to 800	35	2
801 to1 300	50	3
1 301 and above	75	4

8.2.5 The lot shall be declared as conforming to the requirements of the specification, if the requirements for various characteristics as given in **8.2.3** and **8.2.4** are satisfied.

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